

The importance of physical fitness for pencak silat athletes: Home-based weight training tabata and circuit can it work?

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ABSTRACT

During the Covid-19 pandemic, pencak silat athletes experienced difficulty improving physical fitness because training could not be done together with a coach, so their physical fitness decreased significantly. This study aimed to test Tabata and Circuit's effectiveness to improve female Pencak silat athletes' physical fitness. This research was quantitative with experimental methods. The subject of this research consisted of Female Pencak silat athletes with low physical fitness levels ($n=20$). All subjects were randomly allocated to experiment I of the Tabata weight training (TWT) ($n = 10$) and experiment II of the Circuit weight training (CWT) ($n = 10$). The results showed that the physical training such as arm muscle strength ($t= 11.00$; $P<0.05$), leg muscle strength ($t= 7.900$; $P<0.05$), muscle endurance ($t= 6.014$; $P<0.05$), flexibility ($t= 10.34$; $P<0.05$), endurance VO₂max ($t= 17.39$; $P<0.05$) and power ($t= 19.20$; $P<0.05$), increased significantly due to the intervention of Tabata weight training. A similar increase occurred in Circuit weight training, physical fitness components, such as arm muscle strength ($t= 4.910$; $P<0.05$), leg muscle strength ($t= 12.230$; $P<0.05$), muscle endurance ($t= 4.792$; $P<0.05$), flexibility ($t= 6.107$; $P<0.05$), endurance VO₂max ($t= 5.533$; $P<0.05$) and power ($t= 5.982$; $P<0.05$) increased significantly. Home-based weight training between Tabata and Circuit positively improved the physical fitness of female Pencak silat athletes. This research contributes knowledge in coaching so that lecturers and coaches can use it to improve aspects of athlete's physical fitness.

Keywords: Physical fitness; tabata; circuit



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INTRODUCTION

Martial arts throughout the world has grown rapidly, many martial arts have sprung up, such as Mixed martial arts (MMA), Wing Chun, Krav maga, Karate, Judo, Kungfu, Tai Chi, Shorinji Kempo, Brazilian Jiu-jitsu, Taekwondo, Muay Thai and Pencak Silat. These martial arts have unique and different stance characteristics (Tack, 2013). Pencak silat, one of the martial arts, grows rapidly in several regions in Indonesia (Kartomi, 2011). Pencak silat matches are carried out in three rounds, the average heart rate of athletes reaching 80% of MHR, hence pencak silat is high intensity sport (Nugroho, 2020). Pencak Silat

athlete ought to have good physical fitness (Saputra, Mulyana, Komarudin & Sartono, 2017), to make the basic techniques of hit, kick and slash can be performed optimally. Physical fitness has a definition as a set of attributes related to a person's ability to do physical activities or sport (Roth et al., 2019), such as cardiorespiratory endurance, strength, flexibility, speed, and power (Lee, Kim, & Jeon, 2018; Setiawan, Budiarto, Afriyandi, 2020). Physical fitness has been claimed to be one of the factors to support athletes' performance during training and competition (Saputra et al., 2017). Based on the results of previous studies, it was reported that if physical fitness is not continuously trained it will experience a significant decrease (Vassilis, Yiannis, Athanasios, Dimitrios, Ioannis, & Thomas, 2019). Some studies showed the decrease in physical fitness after 8 to 12 weeks of inactivity (Ingle, Sleaf, & Tolfrey, 2006). Therefore improving physical fitness is not an easy task for the current era, therefore, we need the training method (Tabata and Circuit) that can be used by athletes anytime and anywhere (e.g., home, indoor/outdoor).

Tabata is an exercise that combines intermittent and high-intensity (Joo, 2015). Tabata is a four minute interval training consisting of 8 rounds of work maximally for 20 seconds, each training is followed by 10 seconds of rest (Sumpena & Sidik, 2017; Setiawan et al., 2020). Furthermore, Tabata training can also be applied in 20 to 60 minutes (Rýzková, Labudová, Grznár, & Šmída, 2018). Tabata cannot be applied too often, it is recommended once or twice a week, or 3 days a week (Batacan Jr, Duncan, Dalbo, Tucker, & Fenning, 2017). The previous study showed that Tabata training is less pleasant or eliminates the pleasure in exercising (Foster et al., 2015). Other studies report that Tabata training is seldom used to improve physical condition because some trainers do not know the benefits of this exercise and still doubt the effectiveness of Tabata training (Sumpena & Sidik, 2017). In addition, a recent study on Tabata training reports that Tabata training does not have an effect on muscle strength (Setiawan et al., 2020). Consequently, this research is important to be performed as a way to uncover the issue. Moreover, some studies about Tabata only focused on increasing VO_{2max} (Greenlee et al., 2017) and reducing obesity rates (Khammassi, Ouerghi, Hadj-Taieb, Feki, Thivel, & Bouassida, 2018; Gerosa-Neto et al., 2016), normalizing hyperglycemia in type 2 diabetic females (Ahmad, 2019). However, there is little literature that discusses Tabata with the physical fitness of pencak silat athletes, so this research is important to do.

Circuit training has a definition as an exercise by involving a series of different exercises at each post that is carried out sequentially and continuously for one turn. Circuit training-combines resistance training and high-intensity. Circuit training can be done with gymnastics, handheld weights, exercise machines, where the posts used are usually from 5 to 8 posts and exercises at each post that is carried out less than one minute (e.g. 15-40 seconds), 20 seconds to rest in each post (Kim et al., 2018). Then the duration of the Circuit exercise is around 20 to 35 minutes (Plevková & Peráčková, 2019) and some of the training is around 50 to 60 minutes each time (Kim & Lee, 2019). Previous research has found that Circuit training can increase muscle strength (Wilke et al., 2019), and can increase mobility and stamina (Yadav & Sardar, 2017). Some studies have examined Circuit training that combining Circuit training with machine for increasing muscle strength and body composition (Lehnert, Stastny, Sigmund, Xaverova, Hubnerova, & Kostrzewa, 2015), then used Circuit training to improve the body image of primary school girls (Plevková & Peráčková, 2019).

Although there have been many studies on Tabata and Circuit training, however there are no studies that report the influence of Tabata and Circuit on the physical fitness of pencak silat athletes. In addition, previous studies only examined the effects of each training separately not comparing the training simultaneously. The addition of Tabata and Circuit groups is supposed to improve the physical fitness component. This study aimed to examine the effectiveness of both exercises between Tabata and Circuit to improve the physical fitness of Female athletes of pencak silat. The urgency of this research has an impact on science in the field of training methods, so that later coaches and athletes can use the Tabata and Circuit to increase their physical fitness level, even when they are at home.

METHODS

Subject

Twenty Female pencak silat athletes with low level of physical fitness became the subjects of this study. The sampling technique used was purposive sampling by determining the criteria for low levels of physical

fitness in athletes. All voluntary subjects were randomly allocated to experiment of the Tabata weight training (TWT) (n= 10) and experiment II of the Circuit weight training (CWT) (n = 10) (see Table 1). Before starting the study, subjects were informed about the study orally and then submitted their written informed consent to the researchers. This research was conducted ethically in according to international guidelines. All participants lived in a city located in the West Java (Indonesia).

Table 1. The Characteristics of The Subjects

Group (n=20)	Age (yr)	Height (cm)	Weight (kg)
TWT (n=10)	20.60±1.1	1.72±2.5	60.20±2.7
CWT (n=10)	20.00±1.5	1.73±1.5	59.80±1.4

Values are presented as mean±standard deviation.

TWT=Tabata weight training; CWT=Circuit weight training; n= Subjects.

Tabata weight training program

Tabata weight training was done 3 times a week on Tuesdays, Thursdays and Saturdays. Subject moved to Tabata weight training, consisting of 20 seconds for one exercise with 10 seconds intervals (e.g., running on the spot for 20 seconds, and rest for 10 seconds; squat for 20 seconds, and rest 10 seconds, and so on). This cycle was repeated from 2 until 3 sets, total 4 minutes of workout (see Table 2).

Table 2. Tabata Weight Training Program

Training component	Exercise activities	Duration	Intensity
Warm-up	Proprioceptive neuromuscular facilitation (PNF) and jogging.	10 min	40-50 % HRmax
Focus on practice	Tabata workouts 3 sets of 20 seconds high intensity training (e.g., running on the spot, squat, jumping jack, dumbbell, jack knife, high knee with load on the leg, plank with load on the arm, mt. climber), and 10 seconds of rest.	5 min	70-90 % HRmax
Cool-down	Stretching.	10 min	40-50 % HRmax

Circuit weight training program

In this study the authors applied the Circuit weight training program 3 times a week (Tuesdays, Thursdays and Saturdays) for 12 weeks with 40 minutes. All subjects post 1 dumbbell, post 2 sprint 2 meters, post 3 push up diamond, etc (See Table 3).

Table 3. Circuit Weight Training Program

Training Component	Training Activities	Duration	Intensity
Warm-up	Dynamic and static stretching	5 min	40-50% HRmax
Focus on practice	Circuit workouts (posts 1: jogging, pos 2: dumbbell, posts 3: sprint distances 2 meters with load on the arm, posts 4: push-up diamond with load on the arm, posts 5: Lunges with body weight, posts 6: pull up, pos 7: squat jumps).	30 min	70-90% HRmax
Cool-down	Stretching.	5 min	40-50% HRmax

Procedure

The study was conducted for 3 months started June until August, 2020 (12 weeks) and approved by the local ethics committee Suryakencana University (approve date 06.05.2020 number: E-20-114-2020) and was carried out according to the Helsinki declaration criteria (e.g. its basic principle is respect for the individual, the right to give consent after obtaining an explanation of involvement in the research, the safety of the subject must always take precedence over the

interests of science) (Jumareng, Setiawan, Patah, Aryani, Asmuddin, & Gani, 2021). Subjects of this study was the program Tabata and Circuit weight training in home of each athlete and monitored by the researcher through zoom meeting, for example, researchers observe subjects doing Tabata and Circuit weight training through zoom meetings from the beginning to the end of the activity, this is done in order to prevent transmission of COVID-19. The study was conducted by following the standard COVID-19 protocol, for example, check the body temperature first, then give a Hand sanitizer.

Measure

We measure physical fitness related to arm muscle strength was measured with a hand grip strength (Takei T.K.K. 5401 Grip-D Tokyo, Japan) (Kim et al., 2018). This test can measure the static strength of the hand muscles. This test has a face validity and reliability of 0.90. Leg muscle strength was measured with a leg dynamometer (Takei T.K.K. 5402 Back-D Tokyo, Japan), This test has a validity level of 0.60 and a reliability of 0.65. Muscle endurance was measured for 60 sec using sit up. This test has a face validity level and a reliability level of 0.91. Flexibility was examined using sit and reach. This test has a face validity and reliability of 0.92. Endurance VO_{2max} was evaluated by multistage fitness test and. This test has a validity level of 0.92 and a reliability of 0.96. Power was examined using medicine ball throw test. This test has a validity level of 0.77 and a reliability of 0.84.

Statistical analysis

The data were analyzed using IBM SPSS Statistics 25.0. Analysis differences in physical fitness before and after program intervention, we used paired sample t-tests. All values were expressed as mean±standard deviation. $P<0.05$ was considered significant (Kim et al., 2018).

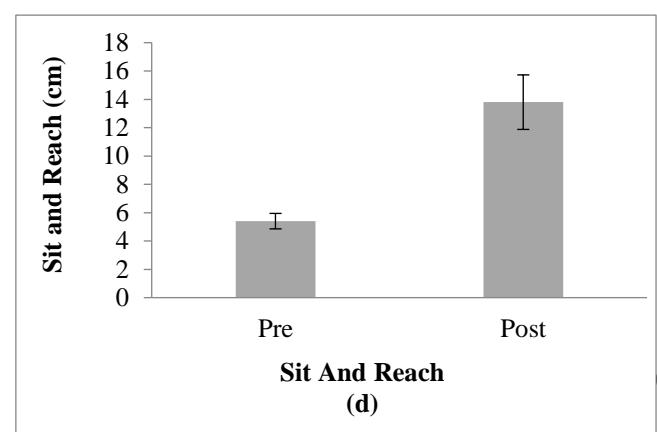
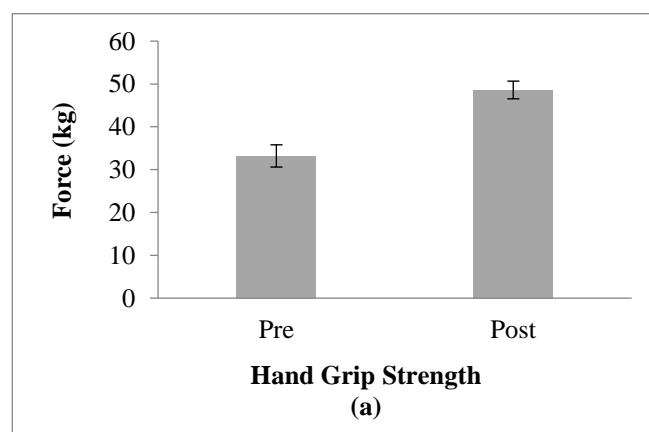
RESULTS AND DISCUSSIONS

The results of this study showed that the physical training of pencak silat Female athletes increased significantly because of the intervention of Tabata weight training. Components of physical fitness, such as arm muscle strength (hand grip strength) ($t= 11.00$; $P<0.05$), leg muscle strength (leg dynamometer) ($t= 7.900$; $P<0.05$), muscle endurance (sit up) ($t= 6.014$; $P<0.05$), flexibility (sit and reach) ($t= 10.34$; $P<0.05$), endurance VO_{2max} (multistage fitness) ($t= 17.39$; $P<0.05$) and power (medicine ball throw) ($t= 19.20$; $P<0.05$), the data showed an increase in all components of physical fitness (see Table 4), the change in values between the pre-test and post-test all components of physical fitness in Tabata weight training as seen in Figure 1.

Table 4. The Result for Physical Fitness Tabata Weight Training

Variable Physical Fitness	Pre	Post	t	P-value
Arm Muscle Strength	33.20±2.5	48.60±2.0	11.00	0.000*
Leg Muscle Strength	28.80±3.7	46.00±5.3	7.900	0.001*
Muscle Endurance	22.20±1.9	31.40±2.8	6.014	0.004*
Flexibility	5.40±5.4	13.80±1.9	10.34	0.000*
Endurance	32.14±2.8	64.09±2.2	17.39	0.000*
Power	10.40±6.1	21.60±2.0	19.20	0.000*

Values are mean±standard deviation. * P -value <0.05



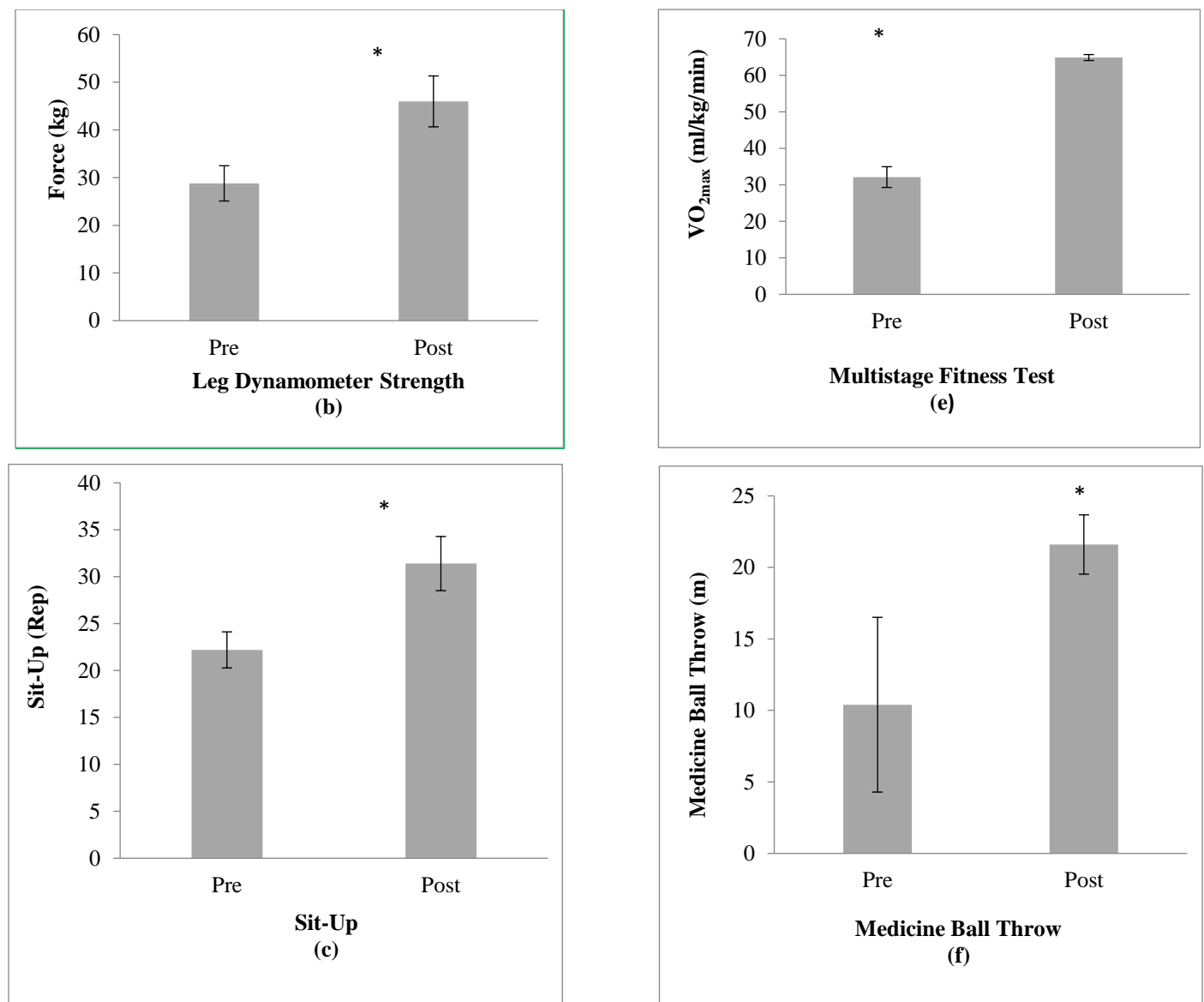


Figure 1.Changes of Hand Grip Strength (HGS) (a), Leg Dynamometer (LD) (b), Sit Up (SU) (c), Sit And Reach (SAR) (d), Multistage Fitness (MF) (e), Medicine Ball Throw (MBT) (f), pre and post 12 weeks of TWT. Significance level was set at * P -value < 0.05.

A similar increase occurred in Circuit weight training, physical fitness components, such as arm muscle strength (hand grip strength) ($t= 4.910$; $P<0.05$), leg muscle strength (leg dynamometer) ($t= 12.230$; $P<0.05$), muscle endurance (sit up) ($t= 4.792$; $P<0.05$), flexibility (sit and reach) ($t= 6.107$; $P<0.05$), endurance VO_{2max} (multistage fitness) ($t= 5.533$; $P<0.05$) and power (medicine ball throw) ($t= 5.982$; $P<0.05$) (see Table 5). While the change in values between pre-test and post-test all components of physical fitness in the circuit weight training can be seen in Figure 2.

Table 5. The Result For Physical Fitness Circuit Weight Training

Variable Physical Fitness	Pre	Post	t	P-value
Arm Muscle Strength	33.40±4.2	50.80±4.2	4.910	0.008*
Leg Muscle Strength	26.80±3.7	53.20±4.6	12.230	0.000*
Muscle Endurance	21.00±2.3	35.80±5.2	4.792	0.009*
Flexibility	5.60±5.4	12.40±2.5	6.107	0.004*
Endurance	32.28±2.5	52.20±10.2	5.533	0.005*
Power	8.40±1.6	14.20±8.4	5.982	0.004*

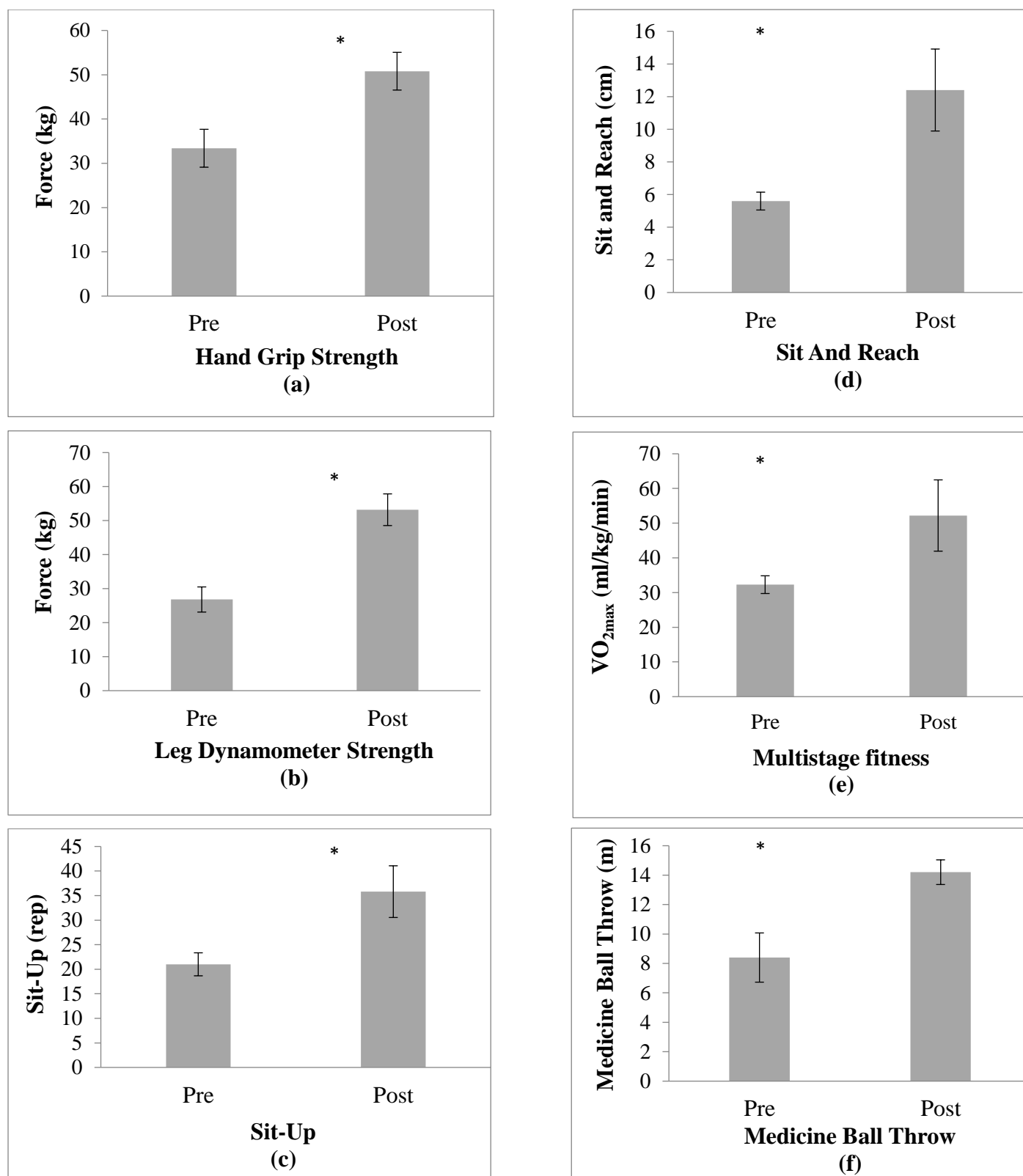


Figure 2. Changes of Hand Grip Strength (HGS) (a), Leg Dynamometer (LD) (b), Sit Up (SU) (c), Sit And Reach (SAR) (d), Multistage Fitness (MF) (e), Medicine Ball Throw (MBT) (f), pre and post 12 weeks of CWT. Significance level was set at * P -value < 0.05.

The purpose of our study was to assess the effectiveness of tabata and circuit weight training on improving physical fitness.

The Effects of Tabata Weight Training on Physical Fitness

Muscle strength is a physical fitness component needed by athletes during the competition (Akinoğlu & Kocahan, 2018). The results of this study report that 12 weeks of Tabata weight training can significantly increase muscle strength in the legs and arms. The increase that occurs in the muscle of the arms and legs is due to the combined effect of Tabata + weight training (Tabata, 2020), and Tabata training is claimed can increase muscle performance (Mcrae et al., 2012). The results of previous studies indicate the potential of high-intensity exercise (90% of MHR) for 12 weeks that can be an effective approach to improve components of physical fitness that is lower-body muscle, upper-body muscle (Hurst et al., 2019). The results of this study are supported by previous studies that prove that Tabata training may be an effective exercise modality to influence muscle strength (Blue et al., 2018; Sculthorpe et al., 2017). A similar increase occurred in another physical fitness component, muscular endurance, this is because the 12-week research program from Tabata weight training with a total of 33 sessions was enough to increase muscular endurance athletes. Previous studies also showed that HIIT/Tabata can be used to improve VO_{2max} and other muscular endurance aspects (Menz et al., 2019). Another component of physical fitness that increases the impact of the application of Tabata is flexibility. The results of this study are consistent with previous studies that showed Tabata training for 8 weeks resulted in increased flexibility of hamstring muscles (Rýžková et al., 2018).

The VO_{2max} endurance component is one of the most important elements for athletes to ensure success in training sessions or in the competition (Astorino et al., 2012). In this study, the endurance component has been shown the positive increase of the impact of the Tabata weight training program with a high intensity of 70-90%. For increasing VO_{2max} endurance, generally supportive periods of exercise at high VO_{2max} levels (above 90%) (Rønnestad et al., 2014). Other studies have proven Tabata training to be an effective training method in improving cardiorespiratory fitness (maximal oxygen consumption) (Astorino et al., 2012). Usually the increase in endurance is caused by the use of classical endurance training methods, such as running, bicycle training (Tabata, 2020) and rowing (Buckley et al., 2015). But currently, Tabata training induces an improvement in the aerobic system at the same level as traditional endurance training, but with the added benefit of improving muscle performance (Buckley et al., 2015). Four minutes of Tabata training (eg, burpees, jumping jacks, Mt. Climber) is performed four times per week for four weeks, resulting in a similar increase in VO_{2max} endurance (Mcrae et al., 2012). One of the Tabata research in 2019 reported that Tabata training for 6-12 weeks increased the body's VO_{2max} endurance by 9.2-15.0% and maximal accumulated oxygen deficit (MAOD) by 20.9-35.0%. Thus, Tabata weight training is proven to be an effective method for increasing VO_{2max} endurance components.

Our study found that the power component had a positive increase caused by Tabata weight training 3 times a week for 12 weeks. Research (Fajrin et al., 2017) applied that Tabata in plyometric form for 6 weeks showed a significant increase in power. Increased power occurs because of anaerobic activity of the glycolysis enzyme in skeletal muscle increases after Tabata training (Domaradzki et al., 2020). We confirm that 12 weeks Tabata training program significantly increases fitness component. The previous author also emphasized that Tabata training appeared as a method that can improve the fitness component (Martínez-lópez et al., 2018).

The Effects of Circuit Weight Training for Physical Fitness

The results of the Circuit Weight training intervention showed an increase in muscle strength in the legs and arms. The results of this study are in line with previous studies that Circuit training can increase muscle strength (Marcos-Pardo et al., 2019; Jung et al., 2019). Furthermore, Circuit training with the addition of weight training is claimed to be an effective exercise to increase aerobic capacity, muscle strength and endurance (Cardozo et al., 2019). The increase is due to the Circuit training using a high variation exercise program such as consecutive exercises for upper and lower body muscles (e.g. diamond push-ups, pull ups,

squat jumps) (Lehnert et al., 2015). Circuit training has become an effective training strategy to promote strength so that it increases (Mayorga-Vega et al., 2013).

In this study we found that Circuit weight training can improve muscular endurance in martial arts athletes. This finding is supported by previous studies (Mayorga-Vega et al., 2013). Circuit training programs such as dumbbells, diamond push-ups with loads on the arm, Lunges with body weight, squat jumps or having a weight training system are important mechanisms for increasing muscular endurance (Arazi & Asadi, 2012).

We confirm that Circuit Weight training can significantly increase flexibility. A study conducted in Korea on flexibility shows that the Circuit is the main capital to increase flexibility in obese Female, it is because in the Circuit implements high training intensity and frequency of aerobic exercise drills (Kim et al., 2018). Kang and Lee (2012) also reported the same results that the effects of circuit weight training for 12 weeks effectively increased flexibility.

Another finding in this study is the effective Circuit weight training program to increase the VO_{2max} endurance component Sonchan, Moungmee, and Sootmongkol (2017) found that after 8 weeks of the Circuit training program, anaerobic capacity and cardiovascular endurance significantly increased ($P<0,05$) (Birkett et al., 2019).

Power is an important element for pencak silat athletes to produce hard and fast blows, through this research power can be increased after Circuit weight training intervention 3 times a week for 12 weeks. Previous studies state that frequency in the Circuit training program resulting in a significant increase in muscle power (Romero-arenas et al., 2013). Thus, the Circuit weight training program can be used as a guide to improve the physical fitness component. The results of this study are supported by previous researchers that the Circuit training for 7 weeks in the Army in Switzerland was significantly able to improve the physical fitness of the soldiers (Hofstetter et al., 2012). The latest finding in this study is that Tabata weight training is superior in improving components, such as VO_{2max} endurance, power and flexibility. While Circuit weight training is superior in increasing components related to muscle strength and muscular endurance.

CONCLUSION

Tabata and Circuit training by adding weight training, both have proven to be effective in increasing the physical fitness component of Female pencak silat athletes. In addition, the results of this study can be evidence that Tabata and Circuit weight training is one of the fun training for martial arts athletes in the current era. Although the physical fitness component has increased the impact of the Tabata intervention and circuit weight training, there are still limitations in this study, sampel this study used athletes only one gender (female), further study need to be performed with more athletes and add other training, such as Fartlek, Zumba.

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